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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 3 : B29D 3/02, 23/12

A1

(11) International Publication Number: WO 84/ 01124

(43) International Publication Date: 29 March 1984 (29.03.84)

(21) International Application Number: PCT/FI83/00061

(22) International Filing Date: 22 September 1983 (22.09.83)

(31) Priority Application Number: 823269

(32) Priority Date: 23 September 1982 (23.09.82)

(33) Priority Country: FI

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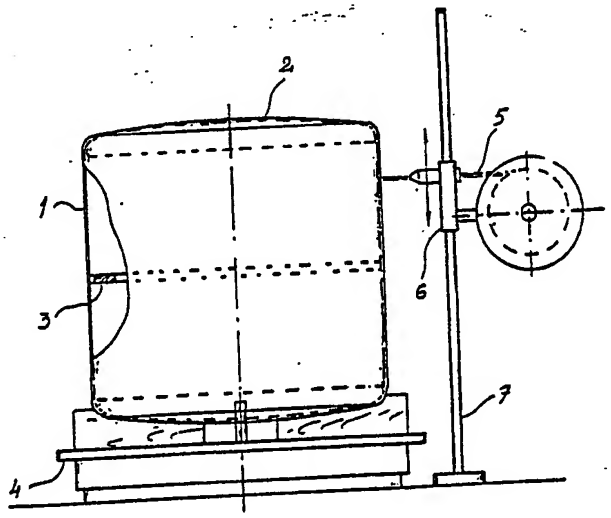
(81) Designated States: AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), DK, FR (European patent), GB (European patent), LU (European patent), NL (European patent), NO, SE (European patent), US.

Published
With international search report.
In English translation (filed in Finnish).

(54) Title: METHOD FOR THE MANUFACTURE OF THE MANTLE PORTION OF A CISTERN



(57) Abstract

Method for the manufacture of the mantle portion (1) of a cistern of reinforced plastic. It is a common feature of all prior-art methods that the mantle portion (1) is built around an inner mould, which is arranged so as to revolve around a horizontal axis while the reinforcement and resin are being applied. The object of the present invention is to provide a method according to which the inner mould can be eliminated, which takes place so that a prefabricated inner layer is cut into rectangular shape with dimensions corresponding to the desired length of the mantle portion and preferably to its entire circumference, which layer is formed to a substantially cylindrical vertical mantle face, whereat the two opposite edges of the layer are joined together by means of reinforcement and resin, whereupon a number of support rings (3) are inserted into the cylinder so as to provide support during the subsequent lamination, which takes place in an in itself ordinary way.

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Method for the manufacture of the mantle portion of a cistern

The present invention is concerned with a method for the manufacture of the mantle portion of a cistern of reinforced plastic, whereat a prefabricated thin layer, one of whose side faces is possibly provided with a layer of a material resistant to corrosion and chemicals, is cut into rectangular shape with dimensions corresponding to the desired length of the mantle portion and preferably to its entire circumference, the said layer being formed to a substantially cylindrical form, with the said layer being directed inwards, and so that the two rectilinear opposite edges of the full-size layer are placed one against the other and joined together by means of reinforcement and resin so that a continuous mantle face with desired dimension is obtained, whereupon reinforcement and resin are applied onto the thin cylindrical mantle face by winding around the mantle face along a preferably slowly rising spiral-shaped path until desired wall thickness is reached, whereupon the mantle portion is ready for being provided with end pieces or end flanges.

It is a common feature of all prior-art methods for the manufacture of mantle faces for cisterns that the mantle face is built around an inside mould, which is arranged so that it revolves around a horizontal axis while the reinforcement and resin are applied.

The drawback of such a procedure is the fact that the cost of manufacture of the mould itself is rather high owing to the circumstance that it must be possible to reduce the diameter of the mould or to disassemble the entire mould and to remove the mould out of the interior of the mantle face after completed lamination and after hardening of the plastic. When large series of fuel tanks of a little diameter, e.g. 2 metres, are manufactured, the cost of the mould does

not affect the individual tanks excessively, but when large cisterns are manufactured as little series, a limit is soon reached at which the cost of the mould becomes so high that a manufacture is, on the whole, not profitable.

It is a further drawback that one and the same mould can usually be used for one dimension of the mantle face only, which drawback has been eliminated to some extent by means of moulds of inflatable type, which can be used for the manufacture of mantle faces of diameters within certain limits, e.g. between 300 and 2,500 mm or similar. Out of both technical and economic points of view, it is not profitable to manufacture such moulds for diameters in excess of 3,500 mm.

The object of the present invention is to eliminate the above problem, which is achieved by means of a method which is characterized in that the ready-cut thin layer is rolled together into a roll, which is thereupon placed vertically on a base for rolling up and for forming to the said cylindrical form, whereupon a number of detachable support rings are inserted into the object formed, which is not of entirely rigid shape, before lamination.

The further characteristics of the invention come out from the attached claims 1 to 8.

The invention will be described below in more detail with reference to the attached drawing, wherein

Figure 1 is a side view of a cistern manufactured in accordance with the invention,

Figure 2 is a perspective view of a prefabricated layer,

Figure 3 is an illustration of principle of a ready-cut layer that has been rolled together,

Figure 4 is an illustration of principle of the layer of Fig. 3 as rolled to the cylindrical form,

Figure 5 is a side view of a cistern during manufacture as per the invention, and

Fig. 6 shows the cistern of Fig. 5 as viewed from the top.

A cistern of reinforced plastic consists of a mantle portion 1 and of two end pieces 2, the said end pieces 2 being formed against an inner mould. The mantle portion 1 and also the end pieces 2 usually comprise an inner layer, which partly consists of a layer of a material resistant to corrosion and chemicals, a support layer consisting of several layers of reinforcement material and resin, and finally a possible outer layer of reinforcement and resin, which is illustrated in the inset detail enlargement A in the drawing. In order that the lamination of the cistern at the joint between the mantle portion 1 and the end piece 2 should take place in a satisfactory way, it is appropriate to make the edge portions of the end pieces tapered, as is illustrated in the detail enlargement B.

According to the present invention, the mantle portion is manufactured as follows:

Out of a prefabricated thin layer 1a, whose thickness is, e.g., 2.5 mm and one of whose side faces is possibly provided with a layer of a material resistant to corrosion and chemicals, as is shown in the detail enlargement C in the drawing, a rectangular sheet is cut out whose dimensions correspond to the desired length of the mantle portion and preferably to its entire circumference. The cut-out layer is appropriately rolled into a roll in accordance with Fig. 3, which roll is then turned to the vertical position and placed on a base 4 for the formation of the cut-out layer 1a to a substantially cylindrical form, with the said layer resistant to corrosion turned inwards, so that the two opposite rectilinear edges of the full-size layer 1a are placed against each other and joined together by means of reinforcement and resin, as comes out from Fig. 4. When the ready cut-out layer 1a is in the rolled-together form, its following

handling is facilitated considerably. The different parts of the cistern can, for example, be transported separately to the ultimate site of construction of the cistern, where it is then assembled, but even if the assembly takes place within one and the same factory, a roll is considerably easier to handle than a large sheet of not entirely rigid shape. If the cut-out sheet 1a forms only a part of the circumference of the mantle face, which may be the case with very large diameters of cisterns, the different parts must first be joined together before the final cylindrical mantle face can be formed. In such a case, several longitudinal joints are obtained, which has a retarding effect on the manufacture, because the joining together must usually be carried out manually. Thus, one should preferably aim at the situation that the cut-out layer has a length corresponding to the entire circumference of the mantle face.

Into the thin mantle face 1a in this way obtained, which is not of entirely permanent shape, an appropriate number of support rings 3 are inserted hereinafter, which rings are supposed to keep the thin mantle face in the correct position and to maintain its cylindrical shape during the subsequent lamination, whereat reinforcment and resin are applied onto the cylindrical mantle face 1a so that the reinforcement is appropriately wound around the mantle face along a preferably slowly rising spiral-shaped path, at the same time as resin is sprayed or in some other way applied onto the mantle face. This goes on as long as the desired thickness is obtained for the ultimate mantle portion. If desired, certain parts of the mantle portion may be provided with a thicker laminate layer if the construction of the cistern so requires.

After completed lamination and after the resin has hardened, the inserted support rings 3 are removed, the complete mantle portion is turned to the

horizontal position, whereupon the mantle portion is ready to be provided with end pieces 2, or possibly with end flanges, in a usual way by joining together by means of resin and reinforcement.

The base 4 on which the thin mantle face 1a is formed and the subsequent lamination takes place appropriately consists of a rotary table 4, the centering taking place, e.g., by means of the inserted support rings 3. Hereat, the reinforcement 5 and the resin are appropriately applied onto the revolving mantle face by means of an application device 6, which is arranged so as to run back and forth along a vertical guide 7 placed at the rotary table 4. The movement of the application device back and forth takes place either manually or fully automatically. The application device may be appropriately arranged so that it cuts the reinforcement threads 5 into short pieces, which are, by means of a nozzle, sprayed onto the mantle face 1a together with the resin. The reinforcement appropriately consists of fibreglass threads or bands, but other fibrous materials, such as graphite, carbon fibre, asbestos fibre and equivalent, may also be concerned.

In order to achieve adequate protection and adequate stability in the thin mantle face 1a, support rings 3 are appropriately inserted into both of its ends and to the proximity of its middle portion.

Another embodiment of the method involves that the cylindrical thin mantle face 1a is formed in the vertical position on a stationary base, whereas the application device 6 is arranged so as to be guided around the mantle face 1a along a circular path at the same time as it is slowly guided upwards and downwards so that reinforcement and resin are applied onto the mantle face in a spiral form.

When very high cisterns are manufactured, it may prove necessary to manufacture them in two parts, whereat one end piece and one mantle part, comprising

one half of the mantle portion, are joined together and laminated, whereupon the two parts are transported to the site of ultimate assembly, where they are joined together in an appropriate way.

A highly advantageous procedure involves that one of the end pieces 2 or an end flange constitutes a support ring for the bottom end of the mantle face on formation of the mantle face 1a to the cylindrical form, whereat the end piece 2 and the mantle face 1a are fixed to each other by means of point lamination as the mantle face 1a is being rolled up off the roll. In order that a sufficiently robust base should be obtained for the cistern during the formation and lamination, the rotary table 4 must be provided with an appropriate stand shaped in accordance with the bottom contour of the end piece 2. It may also prove necessary to attach the end piece, and so also the cistern, to the rotary table by means of through-going bolts. After the formation of the mantle face 1a, the longitudinal joint formed is point-laminated, whereupon support rings 3 are possibly inserted into the hollow space inside the mantle face 1a, and the upper end piece 2 is placed onto the top end of the mantle face and fixed by means of point lamination. After the different components have been joined together in this way, the joints thereby formed are completed by lamination, whereupon the support layer of the mantle portion 1 is applied by lamination in the way indicated above. After completed lamination, the support rings 3 can be disassembled and removed, e.g., through manhole gates made onto the cistern.

WHAT IS CLAIMED IS:

1. Method for the manufacture of the mantle portion of a cistern of reinforced plastic, whereat a prefabricated thin layer (1a), one of whose side faces is possibly provided with a layer of a material resistant to corrosion and chemicals, is cut into rectangular shape with dimensions corresponding to the desired length of the mantle portion and preferably to its entire circumference, the said layer being formed to a substantially cylindrical form, with the said layer being directed inwards, and so that the two rectilinear opposite edges of the full-size layer are placed one against the other and joined together by means of reinforcement (5) and resin so that a continuous mantle face with desired dimension is obtained, whereupon reinforcement (5) and resin are applied onto the thin cylindrical mantle face appropriately by winding around the mantle face (1a) along a preferably slowly rising spiral-shaped path until desired wall thickness is reached, whereupon the mantle portion (1) is ready for being provided with end pieces or end flanges, c h a r a c t e r i z e d in that the ready-cut thin layer is rolled together into a roll, which is thereupon placed vertically on a base for rolling up and for forming to the said cylindrical form, whereupon a number of detachable support rings are inserted into the object formed, which object is not of entirely rigid shape, before lamination.

2. Method as claimed in claim 1, c h a r a c t e r i z e d in that the thin mantle face (1a) is formed on a rotary table (4) and centered by means of the support rings (3).

3. Method as claimed in claim 2, c h a r a c t e r i z e d in that the reinforcement (5) and the resin are applied onto the revolving mantle face by means of an application device (6), which is arranged

so as to run back and forth along a vertical guide (7) placed alongside the rotary table (4).

4. Method as claimed in any of claims 1 to 3, c h a r a c t e r i z e d in that support rings are inserted at both ends of the mantle face and to the proximity of its middle portion.

5. Method as claimed in any of claims 1 to 3, c h a r a c t e r i z e d in that the lower end piece (2) is attached to and utilized as a support ring for the mantle face (1a) on forming to the cylindrical shape, whereupon the upper end piece (2) is attached to the mantle face (1a) so that it, together with possible support rings (3), if any, should give adequate support during the subsequent lamination.

6. Method as claimed in claim 1, c h a r a c t e r i z e d in that the thin cylindrical mantle face (1a) is formed on a stationary base, whereas the application device (6) is arranged so as to be passed along a circular path around the mantle face (1a) and, at the same time, slowly upwards and downwards so that reinforcement (5) and resin are applied onto the mantle face in a spiral form.

7. Method as claimed in claim 3, c h a r a c t e r i z e d in that the application device (6) is arranged so as to cut the reinforcement threads (5) into short pieces, which are sprayed by means of a nozzle onto the mantle face (1a) together with the resin.

8. Method as claimed in any of the preceding claims, c h a r a c t e r i z e d in that the reinforcement consists of fibreglass threads or bands.

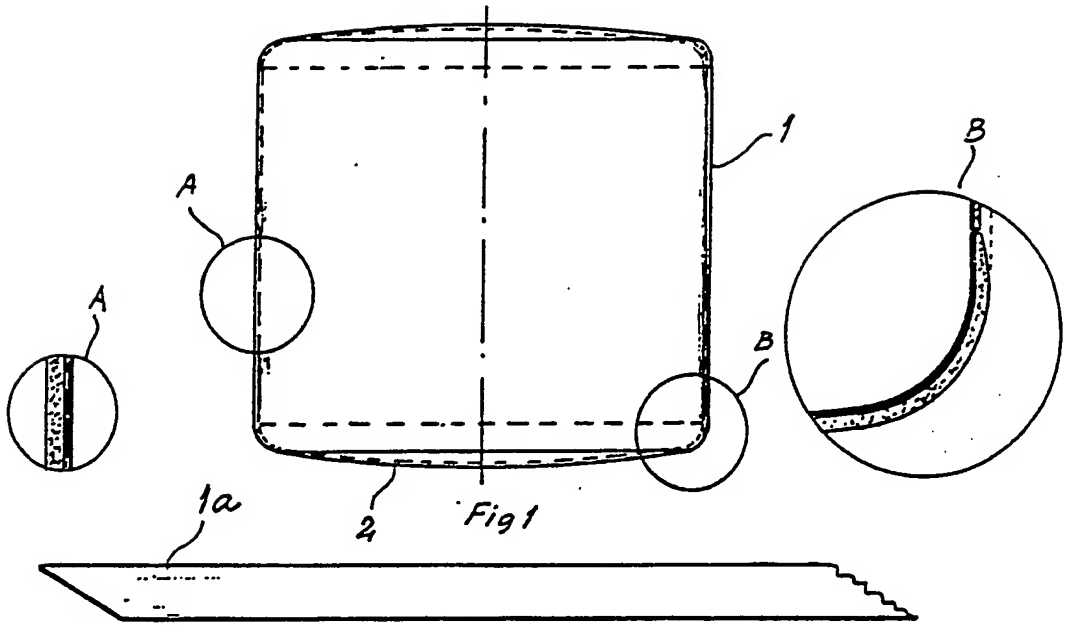

Fig 1

Fig 2

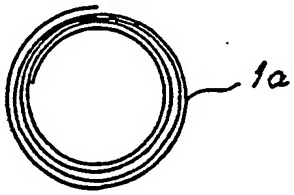

Fig 3

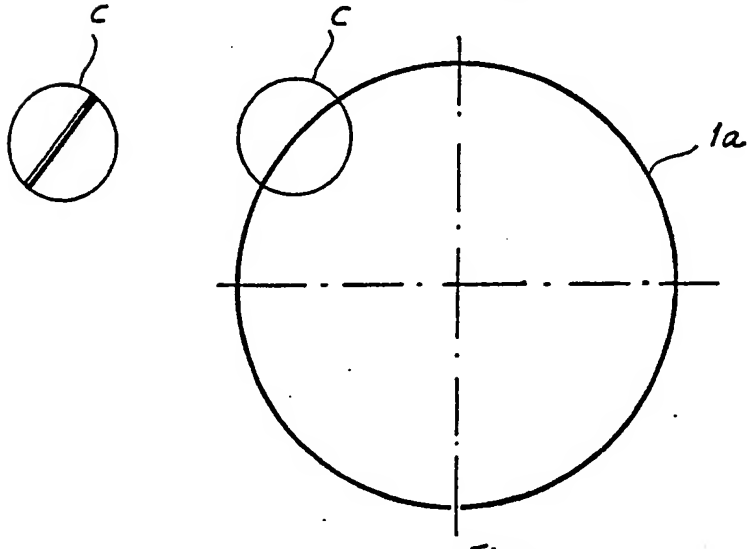

Fig 4

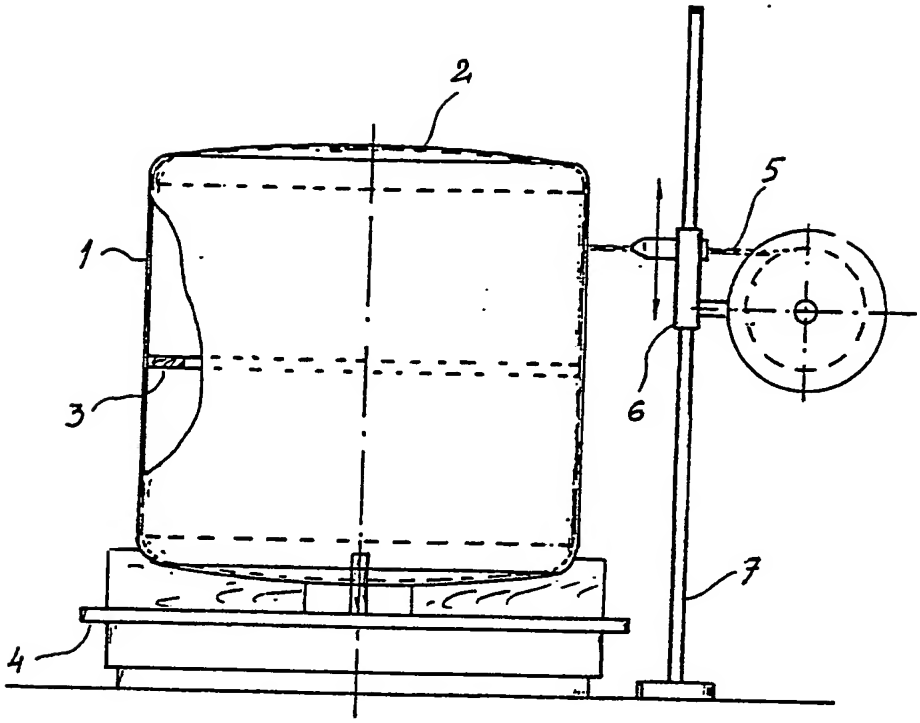

Fig 5

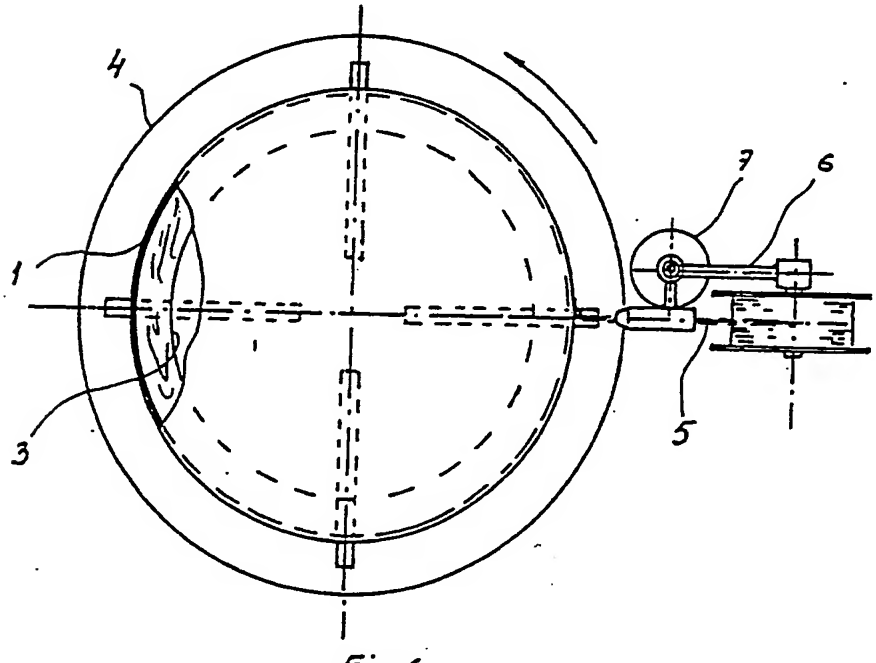

Fig 6

INTERNATIONAL SEARCH REPORT

International Application No PCT/FI83/00061

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC 3

B 29 D 3/02, 23/12

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC 3	B 29 D 3/02, 23/12
US Cl	156:169, I71-174, 184, 185, 187, 190-192, 195

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category [6]	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	FR, A1, 2 216 087 (VETRORESINA SPA) 30 May 1974 & DE 2403184 GB 1449850	1-8
A	US, A, 2 718 583 (DAVID B NOLAN AND JOHN G BRIGGS) 20 September 1955	1-8
A	SE, A1, 324 887 (L H FORNELL) 15 June 1970	1-8
A	US, A, 4 053 343 (J WARNE CARTER) 11 October 1977	1-8
A	DE, B2, 2 117 610 (HOUILLERES DU BASSIN DU NORD ET DU PAS-DE-CALAIS) 15 May 1975	1-8
A	DE, A1, 2 146 784 (MASCHINENFABRIK AUGUS-BURG-NÜRNBERG AG) 10 May 1973	1-8

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
1983-12-09	1983 -12- 21
International Searching Authority [1]	**Signature of Authorized Officer [20]**
Swedish Patent Office	Stefan E Lindén

Form PCT/ISA/210 (second sheet) (October 1981)